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Karen Dalatte
Name

July 24, 2007
Date

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Applicants:	Cetel, et al.	Docket No:	PA-085.10559-US
Serial No:	10/023,565	Examiner:	J.P. Sheehan
Filed:	Dec. 18, 2001	Art Unit:	1742
Title:	HIGH STRENGTH, HOT CORROSION AND Oxidation Resistant, Directionally Solidified Nickel Base Superalloy and Articles	DATE:	JULY 24, 2007

Mail Stop APPEAL
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

REPLY TO NOTICE OF NON-COMPLIANT APPEAL BRIEF

In response to the Notice of Non-Compliant Appeal Brief dated May 22, 2007, Applicants respond as follows:

The Notice indicated that the Brief did not contain items required by 37 CFR 41.37(c) and did not contain a proper status of the claims.

In response, Applicants note that the attached Brief now contains these items.

Applicants believe that no fee is due in connection with this submission. Please charge any fee due to our deposit account number 21-2079.

Respectfully submitted,

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July 24, 2007
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Art Unit: 1742

Title: High Strength, Hot Corrosion and Oxidation Resistant, Directionally Solidified Nickel Base Superalloy and Articles

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APPLICANTS' THIRD SUPPLEMENTAL APPEAL BRIEF

I. *Real Party In Interest*

The real party in interest is United Technologies Corporation, as assignee of the entire right, title and interest in the application.

II. *Related Appeals and Interference*

There are no related appeals.

III. *Status of Claims*

Claims 1 – 3 and 5 - 14 were pending. Claims 1-3 and 5-14 were rejected. No claims were merely objected to and no claims were allowed. Claims 1-3 and 5-14 are on appeal.

IV. *Status of Amendments*

There are no amendments after the final rejection. A copy of the full text and status of all claims is set forth in Section 9, *Appendix*.

V. *Summary of the Claimed Subject Matter*

As set forth in claim 1, a directionally solidified article which comprises a high strength, corrosion and oxidation resistant nickel base superalloy including about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, and consists essentially of (in weight percent) 10 - 13.5% chromium; 8 - 10% cobalt; 1.25 - 2.5% molybdenum; 3.25 - 4.25% tungsten; 4.5 - 6% tantalum; 3.25 - 4.5% aluminum; 3 – 4.75% titanium; 0.0025 - 0.025% boron; up to about 0.05% zirconium (no intentional additions); 0.05 - 0.15% carbon; and having no intentional addition of niobium; no intentional addition of hafnium; and balance essentially nickel. Aluminum + titanium is between about 6.5 - 8%. (see, e.g., page 5, lines 18 – 23, and FIG. 1).

The articles have at least comparable hot corrosion resistance (at 1600 F) (see FIG. 2 and page 6, line 25 – page 7, line 5), and at least equal oxidation resistance (at 2000F) (see FIG. 3, and page 7, lines 6 – 10) to directionally solidified articles having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

As set forth in independent claim 12, a high strength, corrosion resistant, nickel base superalloy adapted for use in columnar grain directionally solidified articles, comprises (in weight percent) about 12 % chromium; 9 % cobalt; 1.9 % molybdenum; 3.8 % tungsten; 5 % tantalum; 3.6 % aluminum; 4.1 % titanium; 0.015 % boron; 0.1% carbon; and having no intentional addition (and in any event less than about 0.02) zirconium and no intentional amount of niobium; balance essentially nickel and incidental impurities (see page 5, lines 27 – 31). Aluminum + titanium is between about 6.5 - 8 % (page 5, lines 22 – 23). The alloy includes a matrix containing from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide (page 5, lines 23 - 24). The article is characterized by oxidation resistance at 2000° F of roughly 2.5 times better (see FIG. 3 and page 7, lines 6 – 10), and creep rupture life at 1400° F of roughly 2.4 times better (FIGS. 4 – 6 and page 7, lines 13 – 18) than a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

VI. *Grounds of Rejection to be Reviewed on Appeal*

a. Whether the Examiner properly rejected claims 1 – 3 and 5 - 14 under 35 U.S.C. § 103 as allegedly unpatentable over WO99/67435 to Esser?

b. Whether the Examiner properly rejected claims 1 – 3 and 5 - 14 under 35 U.S.C. § 103 as allegedly unpatentable over EP 0 855 449 to Mitsuhashi et al.?

c. Whether the Examiner properly rejected the claims for double patenting over commonly assigned application US2004/0200459 ?

VII. *Argument*

a. Claims 1 – 3 and 5 – 14 are patentable over WO99/67435 to Esser.

Esser is directed to a "directionally solidified casting with improved transverse stress rupture strength". Initially, Applicants agree with the Examiner that Esser does not teach the same alloy proportions; does not disclose (either as requiring or precluding) the use of Zr; and is silent with respect to the properties recited in the claims.

Esser appears to have started with the single crystal alloy of U.S. Pat. No. 4,597,809 to Duhl; tried to cast the Duhl (single crystal) alloy in directionally solidified form; and asserted (page 1 of Esser) that certain properties were insufficient. Esser then tried to "convert" the Duhl '809 single crystal alloy by changing the composition for use as a directionally solidified (columnar grain) form. From Tables I and II in Esser, it appears that C content – rather than B content or any suggestion (outside of Esser) of Zr content - is what drives the desirable results (good DS castings - comparing the results of heat 1, with those of 1A and 2).

According to one embodiment in Esser (pp. 4 – 5), a nickel base superalloy consists essentially of 9.5% to 14% Cr, about 7% to 11% Co, about 1% to 2. 5% Mo, about 3% to 6% W, about 1% to 6% Ta, about 3% to 4% Al, about 3% to 5% Ti, about 0 to 1% Nb, and balance essentially Ni and B present in an amount effective to substantially improve transverse stress rupture strength of a DS casting as compared to a similar casting without boron present. There is no mention of Zr content (if any), and no mention of C content (if any), although the existence of other embodiments that do explicitly contain C suggests that this particular embodiment includes no C.

In a "particularly preferred" embodiment (page 5), a casting composition consists essentially of 11.6% to 12.70% Cr, about 8.50 to 9.5% Co, about 1.65% to 2.15% Mo, about

3.5% to 4.10% W, about 4.80% to 5.20% Ta, about 3.40 to 3.80% Al, about 3.9% to 4.25% Ti, about 0.05% to 0.11% C, about 0.003% to 0.015% B, and balance essentially Ni, and is castable to provide a directionally solidified columnar grain microstructure. The microstructure of the columnar grain casting typically includes about 0.4 to about 1.5 volume % of a phase based on tantalum carbide. Again, there is no mention of any Zr content, although the absence of another embodiment that does include any Zr (and the "consisting" language) suggests that there is no Zr in this "most preferred" alloy.

In Esser, the castings were heat treated – at a temperature of about 2300 F (page 8, line 5). Such a heat treatment, applied to the present invention, would destroy the part.

As compared to independent claim 1 of the present invention, the Esser alloy does overlap significant portions of the inventive alloys set forth in claims 1 and 12 – including Cr, Co, Mo, W, Ta, Al, Ti and C. With respect to B content, while there appear to be some overlap between Esser and the present invention, Esser seems to suggest (Tables I and II) that lower B levels (below about 0.01 wt. %) result in alloys that are not useful for directionally solidified parts. In other words, Esser seems to suggest that lower B levels would result in a useless alloy. *On this issue at least, Esser seems to teach away from the present invention (see, e.g., Mod 4 on p. 6 of the present application).*

In addition, Esser does not overlap with claims 1 or 12 for Zr content.

Moreover, Esser does not teach or suggest any oxidation or corrosion resistance values, let alone the improved (unexpectedly so, given the similarity of the compositions values of present independent claims 1 and 12.

For at least the foregoing reasons, Applicants submit that Esser does not teach or suggest the invention as set forth in independent claims 1 and 12. The dependent claims further define the inventions of their respective independent claims, and are thus deemed further patentable. At least with reference to B and Zr content, Applicants respectfully submit that the references to In Re Peterson, etc are not apposite.

b. Claims 1 – 3 and 5 – 14 are patentable over EP 0 855 449 to Mitsuhashi.

Mitsuhashi is directed to columnar crystalline Ni-base heat resistant alloy having high resistance to intragranular corrosion at high temperatures; method of producing the alloy; large size article; and method of producing large size article from the alloy. The alloy is "free of Zr (page 3, line 40) and includes 12 – 14.3 Cr, 8.5 – 11 Co, 1 – 3.5 Mo, 3.5 – 6.2 W, 3 – 5.5. Ta, 3.5 – 4.5 Al, 2 – 3.2 Ti, 0.04 – 0.12 C, 0.005 – 0.05 B, bal Ni.

On page 4, lines 17 – 18, there seems also to be a desire to include small but measurable amount of Pt, Rh, and Re, and Ca and Mg. See also, claim 1. These elements are not included in the alloy of the present invention.

The castings are HIPd at ~ 2150 – 2300 for 1 – 5 hours, and then heat treated at a temperature of 2200 – 2300 F for 2 – 5 hours. At these temperatures, parts prepared according to the present invention would not be useful. However, with reference to page 9, line 56 – page 10, line 5, Mitsuhashi seems to suggest that the absence of Zr is beneficial to suppressing localized melting at higher temperatures, e.g., associate with the solution heat treatments used by Mitsuhashi. Such a heat treatment is not required to get adequate results with the present invention alloys.

As noted above with respect to Esser, Mitsuhashi as compared to independent claim 1 of the present invention, does overlap significant portions of the inventive alloys set forth in claims 1 and 12 – including Cr, Co, Mo, W, Ta, Al, Ti and C. With respect to B content, while there appear to be some overlap between Mitsuhashi and the present invention, also seems to suggest that lower B levels (in this case below about 0.005 wt. %) result in alloys that are not useful for directionally solidified parts.

In addition, Mitsuhashi more clearly does not overlap with claims 1 or 12 for Zr content. Zr levels, according to Mitsuhashi, must be below 5 ppm (~0.0005 wt % - page 7, lines 1 – 8), or else the melting temperature of the alloy will be too drastically lowered, adversely affecting the ability to heat treat the part. In contrast, the alloys of the present invention covered by claims 1 and 12 exhibit significantly higher Zr contents (e.g., page 6, Table, Mod4).

Moreover, Mitsuhashi does not teach or suggest any oxidation or corrosion resistance values, let alone the improved (unexpectedly so, given the similarity of the compositions values of present independent claims 1 and 12.

For at least the foregoing reasons, Applicants submit that Mitsuhashi does not teach or suggest the invention as set forth in independent claims 1 and 12. The dependent claims further define the inventions of their respective independent claims, and are thus deemed further patentable. At least with reference to B and Zr content, Applicants respectfully submit that the references to In Re Peterson, etc are not apposite.

c. Whether the Examiner properly rejected the claims for double patenting over commonly assigned application US2004/0200459?

While the Applicants are unsure about the amount of information available to Examiner on the USPTO databases, Applicants note that: (1) the inventions were commonly owned at the time the present invention was made, and (2) the inventors on the '459 application are the same as the inventors on the present application.

For at least these reasons, Applicants respectfully submit that this ground of rejection has been overcome.

VIII. *Claims Appendix*

The status of all claims and the text of pending claims, with markings to show current changes relative to the immediately prior version, follows.

1. (previously presented) A directionally solidified article having more than one crystal comprising a high strength, corrosion and oxidation resistant nickel base superalloy which comprises a matrix and from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the alloy consisting essentially of, in weight percent, of: 10 - 13.5% chromium; 8 - 10% cobalt; 1.25 - 2.5% molybdenum; 3.25 - 4.25% tungsten; 4.5 - 6% tantalum; 3.25 - 4.5% aluminum; 3 - 4.75% titanium; 0.0025 - 0.025% boron; up to about 0.05% zirconium; 0.05 - 0.15% carbon; and having no intentional addition of niobium; no intentional addition of hafnium; and

balance essentially nickel; wherein aluminum + titanium is between about 6.5 - 8%;

said article having at least comparable hot corrosion resistance (measured at 1600° F.) and at least twice the oxidation resistance (measured at 2000° F) when compared with a directionally solidified having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

2. (original) The article of claim 1, wherein the article comprises a columnar grain, directionally solidified article.

3. (original) The article of claim 2, wherein the article has transverse ductility in excess of 5% at 1400° F and at 1800° F.

4. (canceled) The article of claim 1, wherein the article comprises a single crystal article including a high angle boundary of up to at least about 20°.

5. (original) The article of claim 1 having stress rupture resistance sufficient to ensure that a load of about 27 ksi applied ruptures only after more than 45 hours, and also has a time to 1% creep of more than 15 hours, at 1800° F.

6. (original) The article of claim 5, wherein stress rupture occurs only after more than 85 hours.

7. (original) The article of claim 1, having 11 - 13% chromium; 8.25 - 9.75% cobalt; 1.5 - 2.25% molybdenum; 3.4 - 4.3% tungsten; 4.7 - 5.5% tantalum; 3.3 - 4% aluminum; 3.75 - 4.3% titanium; 0.008 - 0.025% boron; up to about 0.04% zirconium; 0.04 - 0.15 carbon; wherein aluminum + titanium is between about 7 - 8%.

8. (original) The article of claim 1, having about 12% chromium; 9% cobalt; 1.9% molybdenum; 3.8% tungsten; 5% tantalum; 3.6% aluminum; 4.1% titanium; 0.015% boron; 0.025% zirconium; 0.10% carbon; up to about 0.02 Zr and having no intentional addition of niobium; no intentional addition of hafnium; balance essentially nickel.

9. (original) The article of claim 1, wherein the article comprises a gas turbine engine component.

10. (original) The article of claim 9, comprising a turbine blade or vane.

11. (original) The article of claim 1, further characterized by oxidation resistance at 2000° F of roughly 2.5X, and creep rupture life at 1400° F of roughly 2.4X and at 1800° F of at least roughly 1.5X a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

12. (previously presented) A high strength, corrosion resistant, nickel base superalloy adapted for use in columnar grain directionally solidified articles, comprising in weight percent of about 12 % chromium; 9 % cobalt; 1.9 % molybdenum; 3.8 % tungsten; 5 % tantalum; 3.6 % aluminum; 4.1 % titanium; 0.015 % boron; 0.1% carbon; and having no intentional addition (and

in any event less than about 0.02%) zirconium and no intentional amount of niobium; balance essentially nickel and incidental impurities, and wherein aluminum + titanium is about 7.7 %; and including a matrix containing from about 0.4 to 1.5 vol. % of a phase based on tantalum carbide, the article is characterized by oxidation resistance at 2000° F of roughly 2.5X and creep rupture life at 1400° F of roughly 2.4X compared to a similar article having a nominal composition of 14 Cr, 4.9 Ti, 1.5 Mo, 3.8 W, 2.8 Ta, 3 Al, 9.5 Co, 0.01 B, 0.02 Zr, 0.1 C, and balance Ni.

13. (original) The alloy of claim 9, comprising a gas turbine engine component.

14. (original) The article of claim 13, comprising a turbine blade or vane.

IX. *Evidence Index*

None.

X. *Related Proceedings Index*

None.

The Notice of Appeal was filed March 18, 2005. Applicants believe that there are no fees due for submitting this response. Please charge our deposit account 21-0279 for any fees due.

For at least the foregoing reasons, Applicants submit that the independent claims 1 and 12 and their respective dependent claims are allowable over the prior art of record. The Examiner is invited to contact the undersigned if there are any questions.

Respectfully submitted,

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